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Post-Construction Soil Treatments for Stormwater Reduction

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Impacts of Construction Activities on Soil

Extensive Disturbance, Traffic, Compaction

Subsoil Now At Surface

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After Construction?

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Soil Compaction: Poor vegetation establishment, high runoff rate

Actual Measurements

Matt Haynes, MS Thesis

Infiltration ≈ 0 cm h^{-1}

Bulk density ≈ 1.5 g cm^{-3}
(Clayey texture)

What are the options for fixing the compaction problems?

- Hope it fixes itself
- Add topsoil back
- Scarify
- Use a turf aerator (“plugger”)
- Spread gypsum or other product
- Tillage (disk, rotary, chisel, ripper, etc.)
- Tillage - spader

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Tillage

- Many types of implements – good review (agricultural applictions) @ http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_036234.pdf
- In agricultural applications, where most research has occurred, tillage alone may improve infiltration for only one or a few seasons.
- Repeated tillage usually creates a compacted zone just below the depth the implement reaches.

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Various Cultivation Equipment

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Tillage - Spader

- A spader uses a unique mechanism for tilling the soil which may not create a tillage pan

Soil Conditions Critical

- Moisture: lubricates soil particles
  - Too much = damage to soil
  - Too little = poor penetration
- This all depends on soil texture!
- Problem: limited window for operation

Tillage: An Old Option

- Effectiveness
- Longevity
- Amendments
- Equipment
- Plant Selection

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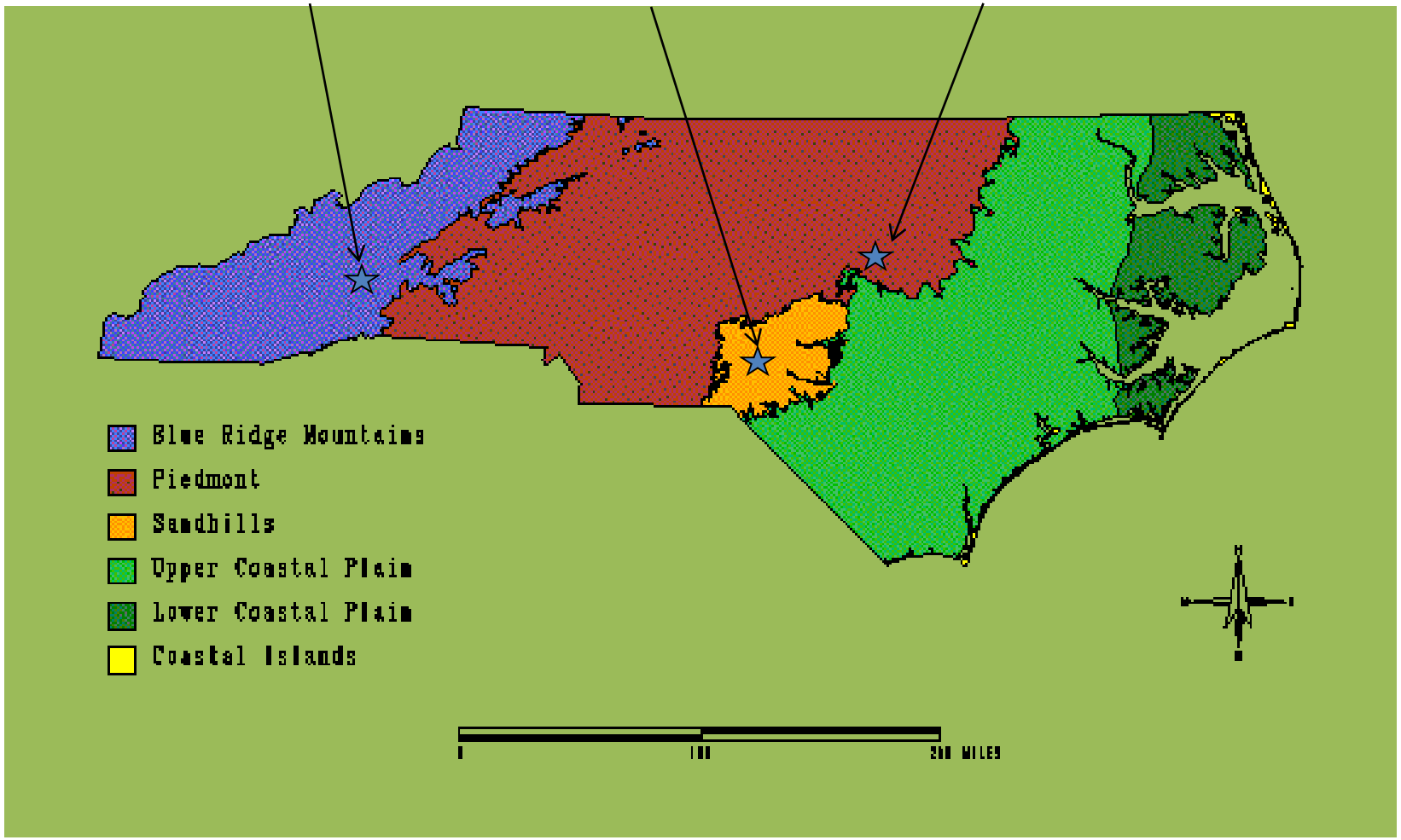
Large, Multi-Year, 3-Site Testing



Plots

ditions:

bsoil.

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Monitor Runoff

(Piedmont; first growing season only)

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Part of Plots Mowed (Traffic), string trimmer on other part (No Traffic)

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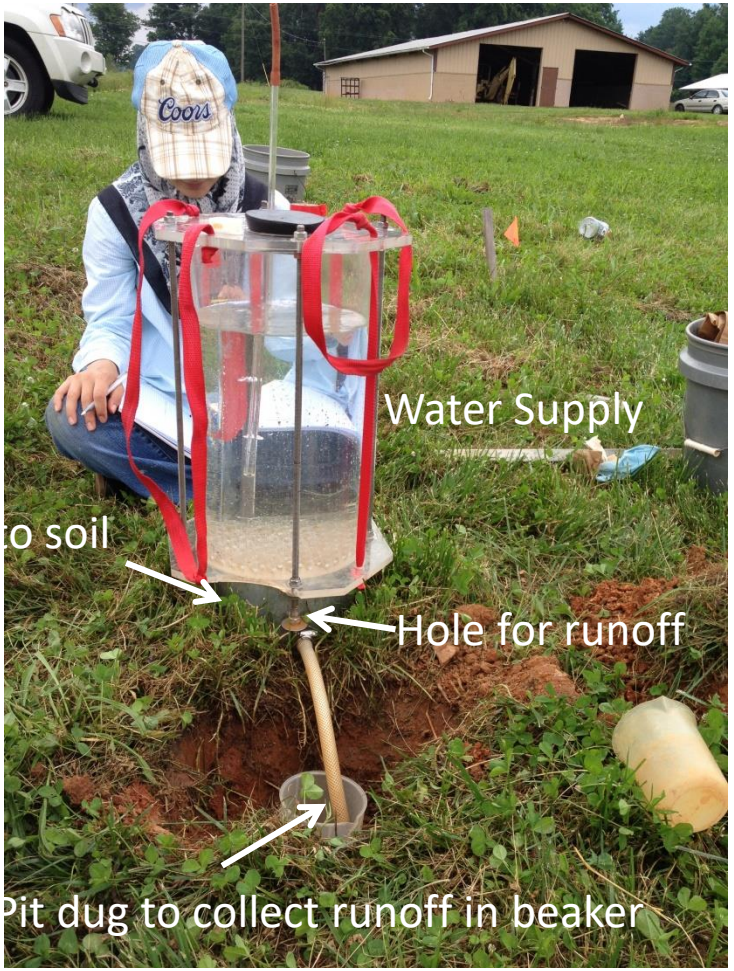
Infiltration Measurement

Cornell Sprinkle Infiltrometer – find steady-state infiltration rate



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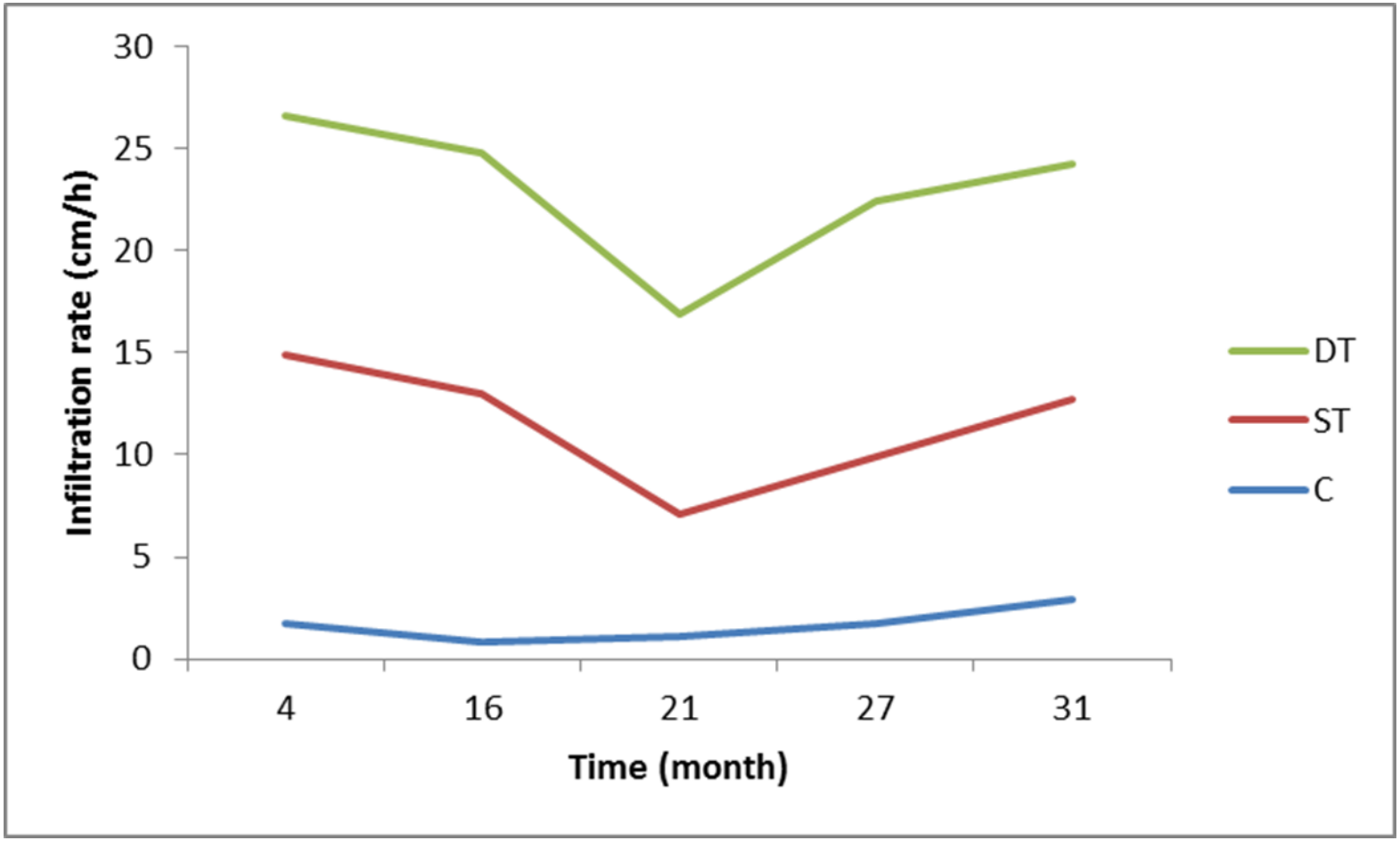
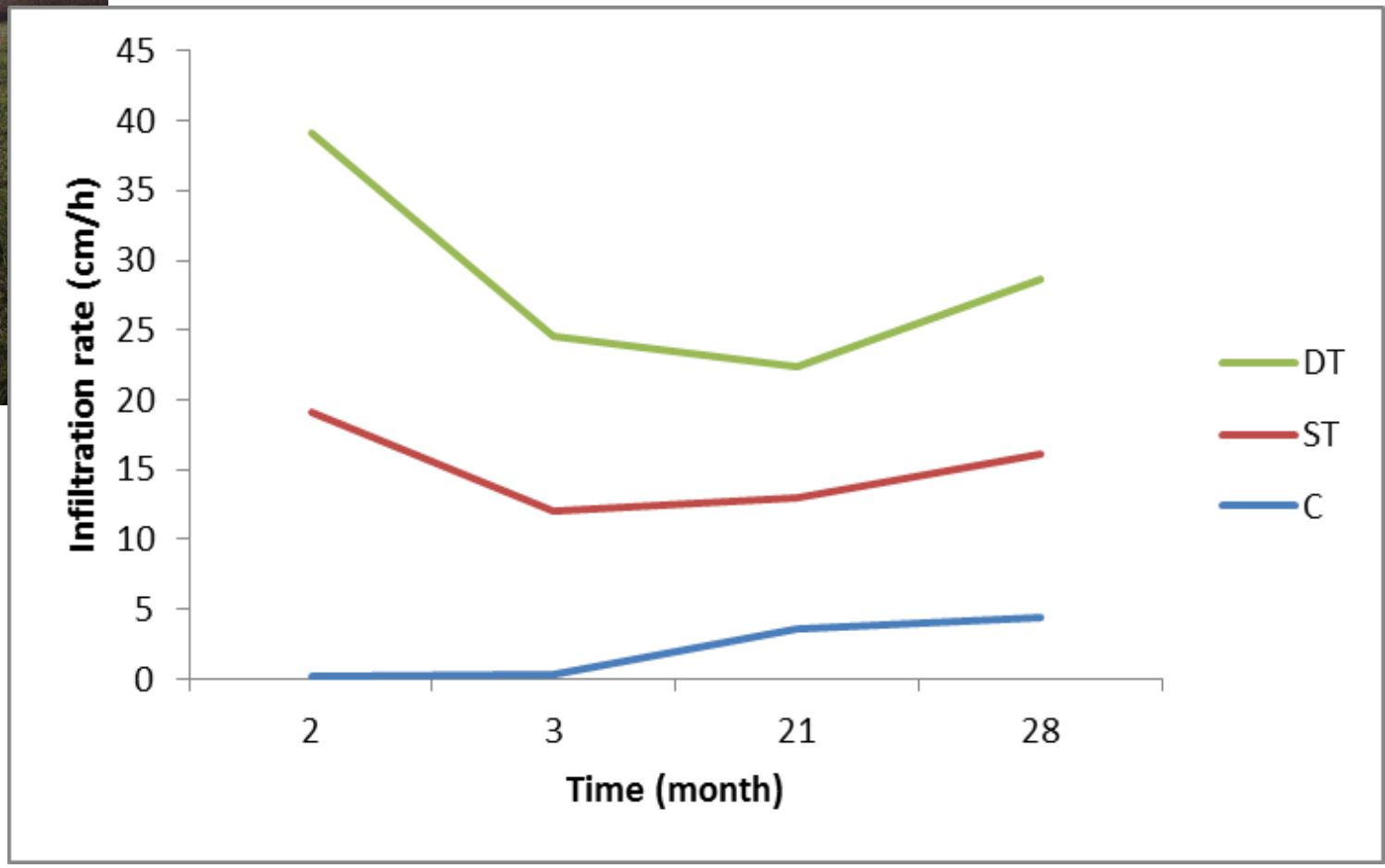
Piedmont #1 Infiltration Rate Over Time



- No lime effect (1x vs 2x)
- No mower traffic effect

Mountain Site Infiltration Rate Over Time



- No effect of x-PAM and compost
- No effect of mowing (traffic)

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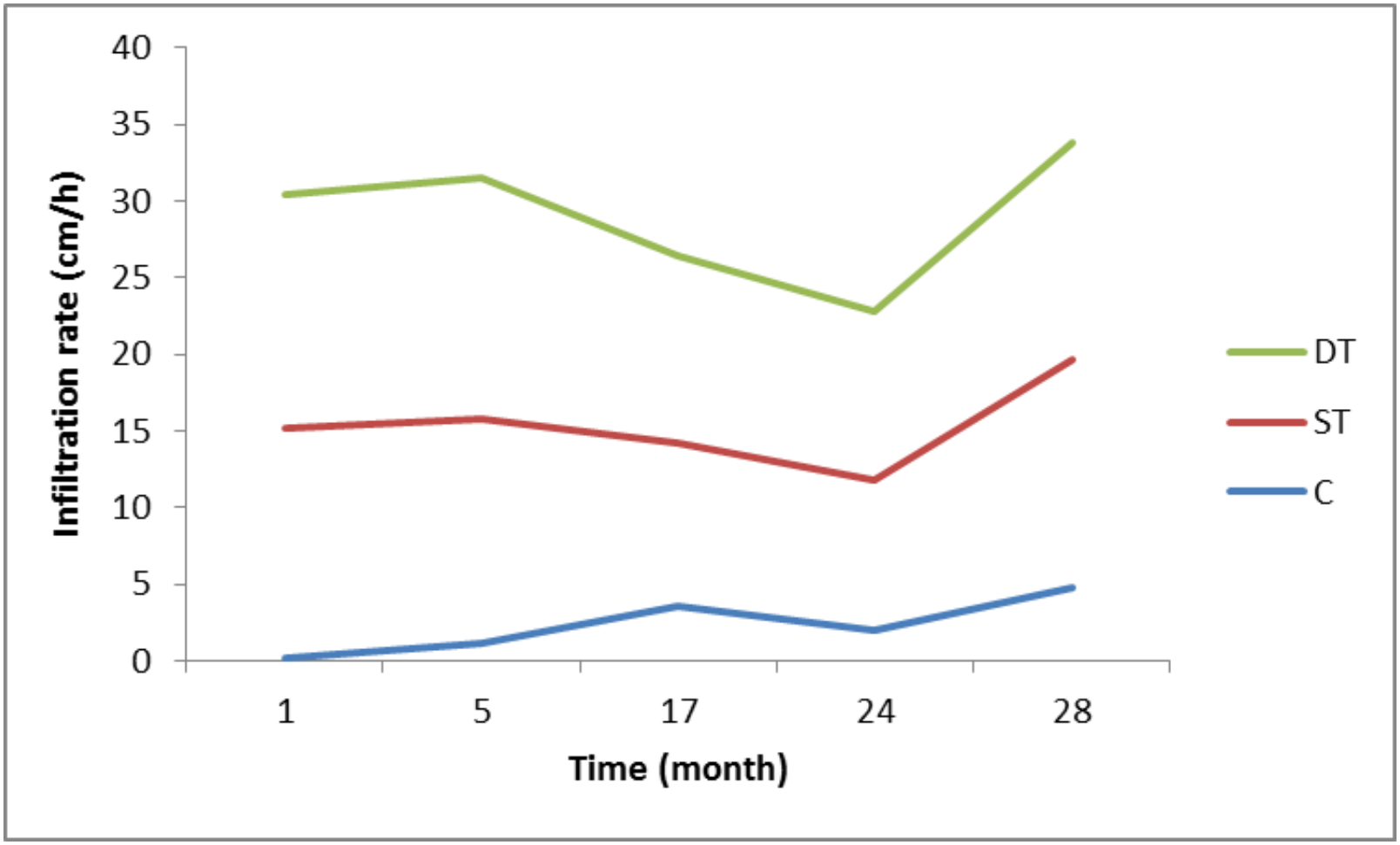
Sandhills Site Infiltrate Rate Over Time



- Lime and compost didn't have sig. difference

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Piedmont #2 Infiltration Rate Over Time

	Time After Treatment (months)		
	6	13	18
Treatments	Infiltration Rate (cm/h)		
Control/Mower Traffic	0.6 b	2.8 b	6.0 b
Control/No Traffic	0.4 b	1.2 b	3.8 b

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Piedmont #2 Infiltration Rate Over Time

	Time After Treatment (months)		
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Treatments	Infiltration Rate (cm/h)		
Control/Mower Traffic	0.6 b	2.8 b	6.0 b
Control/No Traffic	0.4 b	1.2 b	3.8 b
Deep till/Mower Traffic	7.5 a	2.4 b	7.0 b
Deep till/No Traffic	14.8 a	7.0 b	16.8 a

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Piedmont #2 Infiltration Rate Over Time

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Control/No Traffic	0.4 b	1.2 b	3.8 b
Deep till/Mower Traffic	7.5 a	2.4 b	7.0 b
Deep till/No Traffic	14.8 a	7.0 b	16.8 a
Deep till+Compost/Mower Traffic	16.8 a	17.9 a	14.7 a
Deep till+Compost/No Traffic	20.6 a	17.5 a	17.6 a

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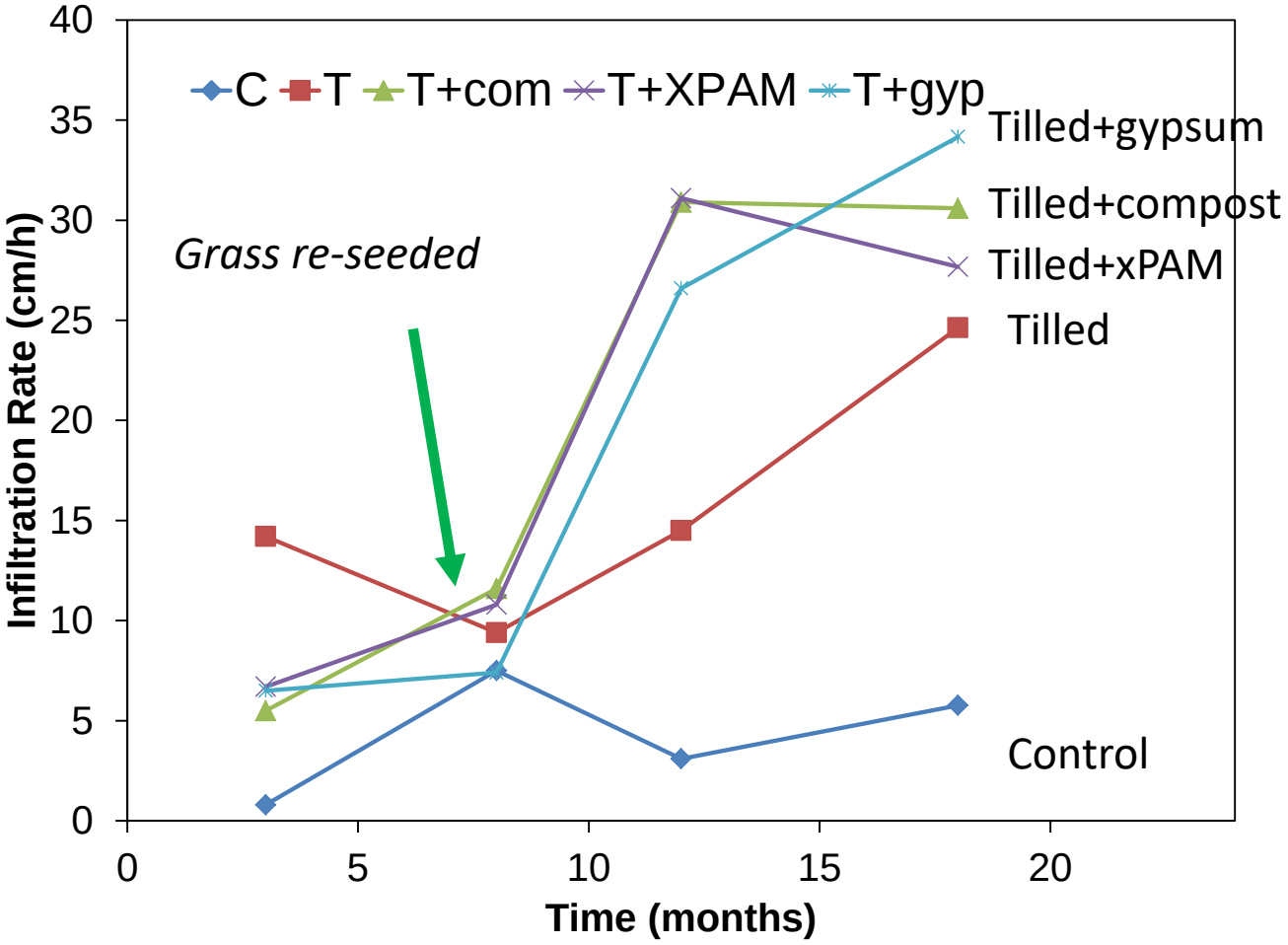
2013 Study: Fill Soil

NCDOT Funding

- Compare compost, gypsum, and cross-linked PAM (water absorbing) in compacted fill soil
- Greenhouse component for root growth
- Field testing on highway construction sites

Fill Soil Tests



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Conclusions To Date

- Compacted soil that was tilled and seeded to grass maintained high infiltration rates for almost 3 years of monitoring.
- Vigorous grass (vegetation) growth is needed, or the tillage effect can be lost.
- Infiltration rates were high enough to suggest runoff from impervious surfaces could be directed to these areas.

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Conclusions (cont.)

- Amendments were not clearly necessary to have high infiltration, but compost may add “resilience” to reduce re-compaction by traffic.
- Heavy equipment may be needed to achieve the “decompaction” level desired.

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Plant Selection

- Some areas will need to be in grass (e.g. roadsides, parks, etc.).
- Some areas can go into woody plants (e.g. landscaping or unused “back side” of lots).
- Flowering plants for pollinators?
- Maintenance?

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Roadside Testing at Two Sites

- Tested tillage on existing soil conditions in long-established shoulders.
- Benefits not as large or consistent.
- Previous studies suggest natural improvement over time.

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Grass vs Wildflowers

- Planting wildflowers instead of grass on high infiltration areas has multiple benefits:
  - Pollinator habitat
  - Low maintenance (once a year mowing)
  - Potential aesthetic appeal
- Is there also a benefit in infiltration?
- Completed 1st of 3 year study.

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First Year Infiltration

Tillage plus…		Coastal Plain	Piedmont	Mountains
		Infiltration rate, cm per hour (in per hour)		
Grass		40 (16)	6 b (2)	54 (21)
Grass+compost		42 (17)	23 b (9)	55 (22)
Wildflowers		44 (17)	19 b (7)	63 (25)
Wildflowers+compost		59 (23)	115 a (45)	71 (28)

-Compost only significant at Piedmont site.
-Plant type had no effect

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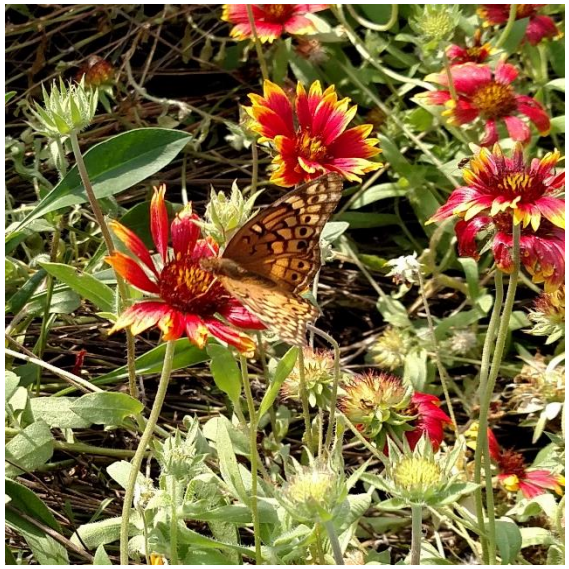
Mower Traffic Effects: Piedmont

Tillage plus…	No Traffic	Traffic
	Infiltration rate, cm per hour (in per hour)	
Grass	6 (2)	0.4 (0.2)
Grass+compost	23 (9)	0.7 (0.3)
Wildflowers	19 (7)	2.7 (1.1)
Wildflowers+compost	115 (45)	2.3 (0.9)

-Traffic significantly reduced infiltration.

-Wildflowers only had 1 mowing, so may explain lower impact.



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Where Can We Apply This?

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Water Is Key!

- We have found that the success of **vegetating a site** is highly correlated to rainfall patterns.
- If water is not available on site, you might consider irrigating with a tanker truck, hydroseeder, or similar.

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Gas pipeline in VA…

Construction halted at Mountain Valley Pipeline work site following severe erosion in Franklin County

By Laurence Hammack laurence.hammack@roanoke.com 981-3239 May 20, 2018 (13)

Storefront

- Cave Spring Corners Kroger to be remodeled
- First Watch prepares for opening in Roanoke